

that the first crystallographic measurements might be obtained: the specimen was presented by Mr. Michael Williams to Mr. Maskelyne for the British Museum, and has ever since been on exhibition in the Gallery. As the crystals were only $\frac{1}{16}$ th of an inch in thickness, the determination of their form was a noteworthy piece of scientific work; and it may be observed that the more recent discovery of larger crystals of the same beautiful mineral in another Cornish locality has only served to confirm the remarkable accuracy with which the form of those acicular crystals was then determined.

A short time ago, Mr. J. C. Williams, whose open-handed generosity is well known in Cornwall, perceiving that the continuance of the collection in so isolated a museum as that of Caerhays Castle prevented its utility both to students and the general public, decided to select some of the specimens for preservation in the family, and to present the remainder to public museums. Accordingly, in a courteous letter, he invited me to Caerhays to select any specimens which would be useful in completing the series preserved in the British Museum, and I immediately went down, accompanied by my colleague Mr. Miers, to examine the collection and remove the specimens which should be selected.

The collection, which amounted to about 10,000 specimens, was exhibited in numerous glazed wall-cases and table-cases in a large hall well lighted from the roof. The specimens were from various parts of the world, but as a rule only those of local origin could be of service for an old-established collection like that of London: the Cornish specimens, however, formed a series which, owing to the closing of so many mines and the change of mineral conditions in others, it would be quite impossible to reproduce in the present day: for the acquisition of such specimens the successive owners of the collection, by reason of their interest in Cornish mining enterprise and its products, have had excellent opportunities of which they have not failed to make use. In all, nearly 300 specimens were reserved by Mr. Williams for continued preservation at Caerhays; 510 specimens have been selected for the British Museum; the collection formed by the late Mr. John Taylor (to whom the British Museum was indebted for the donation of some excellent mineral specimens), and acquired at his decease by Mr. Michael Williams, has been given, with the exhibition-cases containing it, to the Camborne Museum; the remaining specimens and exhibition-cases have been divided between the museums of Redruth and Truro.

That the character and extent of the donation to the British Museum may be more readily appreciated by visitors, the selected specimens have been arranged in four window-cases of the Mineral Gallery, and will be exhibited together for a year or two before their distribution through the main collection. Special attention may be directed to two specimens of blende (sulphide of zinc) which for size and excellence are superior to any yet heard of, and in colour somewhat resemble those from Hungary. A remarkable specimen presenting crystals which are of an emerald-green colour and of unusual form, has been examined by Mr. Miers in conjunction with Mr. Prior, and will shortly be described by the former. He finds the crystals to be identical with spangolite (sulphate and chloride of copper and aluminium); of this species, described by Mr. Penfield three years ago, only one other specimen, found and preserved in the United States, is known to exist. There is a fine suite of crystallised specimens of cassiterite (oxide of tin). Special mention, too, should be made of the specimens of redruthite (sulphide of copper), the large series of specimens of chalcophyllite, clinoclase, and olivenite (arsenates of copper), libethenite (phosphate of copper), lironite (phosphate of copper and aluminium), cupro-uranite (phosphate of copper and uranium), pyromorphite (phosphate and chloride of lead), cerussite (carbonate of lead), chalybite (carbonate of iron), and fluor.

The thanks of Cornish and London students are due to Mr. J. C. Williams for the generosity and self-denial he has shown in parting for their benefit with a valuable collection formed by the efforts of at least two preceding generations of his family.

L. FLETCHER.

PROPOSED NEW TELESCOPE FOR CAMBRIDGE OBSERVATORY.

IN order to complete the equipment of the Cambridge Observatory a public appeal has been made for funds. The appeal reads as follows:—

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"It will be allowed that the Cambridge Observatory ought to be completely equipped for carrying on the most advanced work in modern astronomy. As celestial photography is the branch of astronomy in which the most important advance is now being made, it has been decided that a photographic telescope shall be obtained if the necessary funds be forthcoming. It is the opinion of those most competent to form a judgment that a photographic refractor of about 18 inches diameter would render it possible to attain results of the highest excellence. The new objective would be corrected for the photographic rays, and the present Northumberland telescope would serve as the guide when attached to the new tube. With such an exceptionally efficient instrument the director of the observatory would devote the attention of the staff (presently to be liberated by the termination of the international zone work on which it has been engaged for many years) to the investigation of stellar parallax. At the same time the telescope would be admirably adapted for other work. The twin instrument would be erected in the building at present occupied by the Northumberland equatorial, but a new dome, mounting, and driving clock would be required.

"The scheme sketched above has received the general sanction of the senate of the university, and the observatory syndicate are authorised to take the preliminary steps necessary to carry it out.

"The estimated cost for the new objective with the mounting, driving gear, and other adjuncts, is £2450. To this must be added £500 for the new dome, while the apparatus for measuring the photographs would cost £150. With the moderate allowance of £100 for extras, the total sum wanted is found to be £3200. The observatory syndicate have had under their consideration the means of providing this sum. There is a 'Special Sheepshanks Fund' available for the purchase of astronomical instruments for the Cambridge Observatory. This fund amounts at present to about £1500, of which about £1000 might be prudently expended. Accordingly about one-third of the money now required could be taken from the special Sheepshanks fund, whilst the remaining two-thirds would have to be raised otherwise. As the state of the university finances renders it hopeless to expect that any large sum could be forthcoming for this purpose from the university chest, it only remains to make an appeal to the public. The syndicate would therefore urge the friends of the University of Cambridge, and those interested in astronomical science, to render substantial aid in the furtherance of this project. They accordingly ask for donations towards the sum of £2200 which they have shown to be requisite for the full efficiency of the Cambridge Observatory.

Subscriptions will be received by Sir Robert Ball or by any of the following members of the observatory syndicate:—John Peile (vice-chancellor), G. G. Stokes, G. D. Liveing, G. H. Darwin, H. M. Taylor, and W. W. Rouse-Ball. A list of subscriptions will be duly announced after replies to the appeal have been received.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE University Extension movement has hitherto received no assistance in the form of grants from the Government. But now that the movement is recognised as an educational power in the land it should be subsidised to a certain extent. As Prof. Stewart remarked in the course of a speech on the subject, delivered in connection with the summer meeting at Cambridge, "There was no sum of money that could be better spent by the State for educational purposes than a grant, say of £5,000 a year, to the university extension movement, because thereby they would render the £6,000,000 a year paid for elementary education so much more effective and productive, seeing that a very large proportion of university extension students were elementary school teachers." It was afterwards resolved: "That, in the opinion of this conference of university extension students, application should be made as early as possible to the Education Department for aid to university extension work, particularly for subjects not dealt with by the Technical Instruction Act."

UPRIGHT PENMANSHIP is rapidly becoming popular with the teachers and pupils in our schools, if we are to judge from the yearly growth in the number who send in copybooks to Mr. J. Jackson's annual competitions. The prize-list for 1893 just received contains four photographed specimens of prize-

writing, and informs us that 1441 copybooks were sent in (as against 1121 in 1892). An eighth competition is announced for June 1894, when prizes to the amount of £60 will be awarded.

THE following is a complete list of the candidates to whom the University of London has awarded the degree of Doctor of Science this year:—Experimental Physics: Robert Wallace Stewart; Chemistry: Fredk. Daniel Chattaway and John Theodore Hewitt; Zoology: Henry Bargman Pollard; Animal Physiology: John William Pickering; Geology and Physical Geography: John Walter Gregory, William Fraser Hume, Maria Matilda Ogilvie.

SCIENTIFIC SERIALS.

Bulletin of the New York Mathematical Society, Vol. ii. No. 10. July 1893 (New York: Macmillan).—This young mathematical society crowns the previous good work of its *Bulletin*, in this, the concluding number of its second volume, by the translation and publication of Dr. Felix Klein's "programme on entering the philosophical faculty, and the senate of the University of Erlangen in 1872." It is entitled "A comparative review of recent researches in geometry" (pp. 215-249). The author prefixes a note in which he states that the programme had a limited circulation at first, with which he was then fairly well satisfied, but now that Lie's "Theorie der Transformationsgruppen" has appeared, and that an Italian translation has been published in the *Annali di Matematica*, it seems proper that a wider circulation should be given to his expositions. The translation, which is a literal one, has been admirably done by Dr. M. W. Haskell, and we feel sure that its publication will greatly extend Dr. Klein's *clientèle*. A few additional footnotes are supplied here and there. Dr. F. N. Cole continues his previous work with an article on "the transitive substitution-groups of nine letters" (pp. 250-258). He points out that Mr. Askwith (*Quar. Jour. of Mathematics*, vol. xxvi.) gives only 22 of the 34 actually existing types, and discusses the complete list of the transitive groups of this degree, with brief explanations of the processes by which he has obtained them. Prof. Ziwet gives a brief analysis (pp. 258, 9) of the "Index du répertoire bibliographique du Sciences Mathématiques, publié par la Commission permanente du répertoire" (Paris, 1893). Notes, lists of new publications, and the index complete the number.

IN the *Botanical Gazette* for July, Mr. D. M. Mottier has a paper on the embryo-sac and embryo of *Senecio aureus*; his results agree closely with those of Strasburger on *S. vulgaris*; Mr. P. Dietel describes a number of new specimens of Uredinæ and Ustilaginæ; Mr. G. F. Atkinson completes his account of the biology of the organism which causes tubercles in the roots of Leguminosæ; and Mr. C. Robertson contributes another to his series of articles on flowers and insects.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 15.—"On the Annual and Semi-annual Seismic Periods." By Charles Davison, M.A., Mathematical Master at King Edward's High School, Birmingham. Communicated by Prof. J. H. Poynting, F.R.S.

Method of Investigation.—The method adopted is similar to that employed by Dr. C. G. Knott in his paper on "Earthquake Frequency."

If $f(\theta)$ be a periodic function of θ , then

$$f(\theta) = a_0 + a_1 \cos(\theta + a_1) + a_2 \cos(2\theta + a_2) + \dots + a_n \cos(n\theta + a_n) + \dots,$$

from which it follows that

$$\frac{1}{\pi} \int_{\theta-\pi/2}^{\theta+\pi/2} f(\theta) d\theta = a_0 + \frac{2a_1}{\pi} \cos(\theta + a_1) - \frac{2a_3}{3\pi} \cos(3\theta + a_3) + \dots + \frac{2a_n \sin \frac{n\pi}{2}}{n\pi} \cos(n\theta + a_n) + \dots$$

This latter expression gives the mean value of $f(\theta)$ through an interval $\pi/2$ on either side of θ . From it, all terms involving even multiples of θ are eliminated, and the coefficients of all terms after the second are diminished to a greater extent than that of the second.

A definition of the unit earthquake having been adopted, the earthquakes of different districts are classified in half-monthly groups, the first half of February containing fourteen days, and of all the other months fifteen days; and the numbers so obtained are reduced to intervals of equal length (fifteen days). The numbers for the two halves of each month are added together. The mean of the numbers for the six months from November to April gives the six-monthly mean corresponding to the end of January. Six-monthly means are calculated in this way for the end of each month; each mean is divided by the average of all twelve, and the difference between each quotient and unity is multiplied by the augmenting factor 1.589, in order to obtain the correct value of the ratio $a_1 : a_0$. The curve obtained by plotting these reduced means thus gives special prominence to the annual period, by eliminating the semi-annual period and all those which are fractions of six months, and by diminishing the amplitudes of all other periods with respect to that of the annual period.

In investigating the semi-annual period, the numbers corresponding to the first halves of January and July are added together, and so on; the rest of the method being the same as for the annual period. The result gives special prominence to the semi-annual period by eliminating the annual period, and by eliminating or diminishing the amplitudes of all periods less than six months.

Seismic Periodicity in relation to Intensity.—This discussion is founded on: (1) lists compiled from Mallet's great catalogue, first, of shocks which were so slight as to be just perceptible, and, secondly, of those which were strong enough to damage buildings; (2) Prof. Milne's classification of the Japanese earthquakes of 1885 to 1889 according to the areas disturbed by them; and (3) different catalogues relating to the same district, it being obvious that two such catalogues for the same time can only differ by the omission or inclusion of slight shocks.

The following results are obtained:—(1) In both periods, the amplitude is greater for slight than for strong shocks; (2) there appear to be two classes of slight shocks with an annual period, the stronger having their maximum in winter, the weaker in summer; and (3) in the case of the semi-annual period, both strong and slight shocks, as a rule, have nearly the same maximum epochs.

Seismic Periodicity in relation to Geographical Position.—The number of records examined is 62, 45 belonging to the northern hemisphere, 14 to the southern, and 3 to equatorial countries.

1. *Annual Period.*—In every district, and in all but five records (which are obviously incomplete), there is a fairly well-marked annual period. As a rule, different records for the same district agree in giving the same, or nearly the same, maximum epoch. Excluding, however, those which disagree in this respect, we have left 34 records for the northern hemisphere, 9 for the southern, and 2 for equatorial countries. In the northern hemisphere, 4 records give the maximum in November, 16 in December, and 6 in January; in the southern hemisphere, 2 in April, 2 in May, 3 in July, and 2 in August; the end of the month being supposed in each case. As a rule, then, the maximum epoch occurs in winter in both hemispheres. The amplitude of the annual period ranges from 0.05 (New Zealand) to 0.67 (Sicily and Algeria), the average of 57 records being 0.33.

2. *Semi-Annual Period.*—Of the 62 records examined, only 3 fail to show a semi-annual period, the cause of the failure in these cases being no doubt the imperfection of the seismic record. In New Zealand and South-east Australia, the maximum epoch generally falls either in February or March and August or September; in North America, as a rule, in March or April and September or October. But for other regions it does not seem possible as yet to deduce any law. The amplitudes of the semi-annual period ranges from 0.06 (southern hemisphere) to 0.79 (Mexico), the average value being 0.24.

3. In fifteen cases, the amplitude of the semi-annual period exceeds that of the annual period. Eleven of these records include the following insular districts, which are among the most well-marked seismic regions in the world, namely, the Grecian Archipelago, Japan, the Malay Archipelago, New Zealand, and the West Indies. The average amplitude of the annual period in these eleven cases is 0.16, and that of the semi-annual period 0.24; i.e. the average amplitude of the annual period is just half that for all the districts examined, while in the case of the semi-annual period the average amplitudes are the same.

Origin of the Annual Period.—In this, the concluding, section